The 'WYVERN' 160 Metre Solid State Transmitter — Part 2.

by

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The second article in our 3-part series which describes the construction of a comprehensive transmitter design incorporating semiconductors throughout.

IN LAST MONTH'S ISSUE THE OVERALL DESIGN OF THE transmitter was described as also, in detail, were the v.f.o., the wideband driver section and the doubler and driver stage. This month's article covers the power amplifier stage and the power supply. The concluding article, to be published next month, will deal with the modulator, VU meter driver and general assembly and testing.

POWER AMPLIFIER

The circuit diagram for the p.a. stage is given in Fig. 11. This diagram also includes the power switching around S1(a) to S1(e).

The heart of the stage is the BD123 transistor, which has been chosen for three reasons:

(a) the frequency response cut-off fT, of 85mHz gives a more than adequate performance at 2mHz,

(b) the power dissipation capacity of 45W gives a safeguard against overheating and damage,

(c) the VCE (collector-emitter maximum voltage) of 60 volts gives a reasonable safety margin since on modulation peaks the collector to emitter instantaneous voltage (peak) can be as much as four times the normal supply voltage, i.e. 48 volts.

The drive to the base of the BD123 is controlled by RV1, which is mounted on the front panel of the transmitter. TR7 is pulsed on by positive-going r.f. half-cycles. The consequent pulses of collector current passing through the 2 turn winding of L4 are shaped by the 20 turn tuning winding before radiation. Both windings are close-wound, direct on the rod using 20 to 24 s.w.g. enamelled wire.

Loading and tuning adjustments for the p.a. are as for a conventional valve transmitter, with the exception that the loading setting is far less critical, particularly if the aerial is not quarter wave resonant, and final loading adjustments are carried out by means of the drive potentiometer.

It is important to note that all drive components, i.e. RV1, L2 tuning and L3 tuning, are normally set for maximum p.a. current; whereas the p.a. tuning is adjusted for minimum p.a. current.

Always begin tuning operations with RV1 turned up only sufficiently to draw, say, 500mA of current through the p.a. meter, and then perform initial tuning and loading. Gradually increase the drive given by RV1 until the legal maximum (830mA at 12 volts) is achieved, then make final fine tuning adjustments. Failure to follow this procedure could cost an output transistor (about £1).

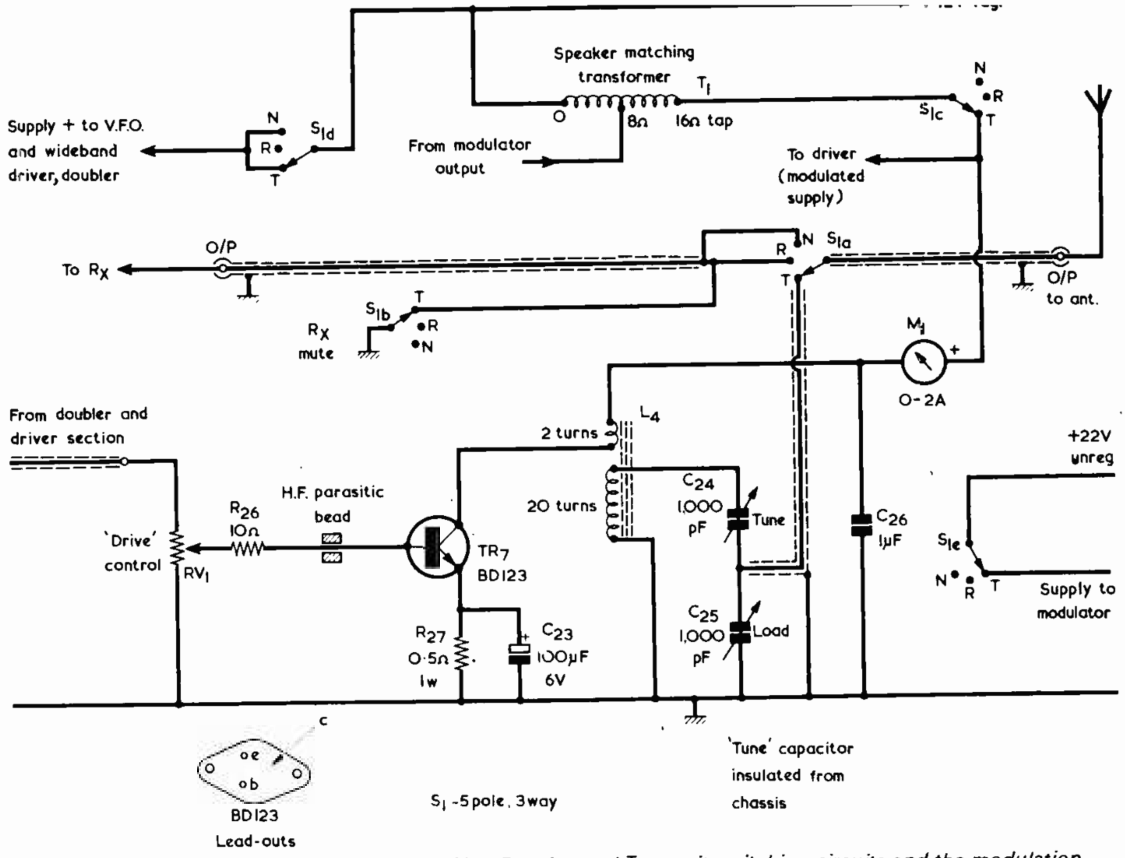


Fig. 11. The p.a. stage. Shown also are the Net, Receive and Transmit switching circuits and the modulation transformer, T1

COMPONENTS

Resistors
(All fixed values ½ watt 10% unless otherwise stated)

R26	10Ω
R27	0.5Ω 1 watt
R28	1kΩ
R29	22kΩ
R30	1kΩ
R31	1kΩ
R32	220Ω
R33	0.25Ω 1 watt, see text
RV1	500Ω potentiometer, wire-wound

Capacitors

C23	100μF electrolytic, 6 V.Wkg.
C24	1,000pF variable
C25	1,000pF variable
C26	1μF plastic foil
C27	1,000μF electrolytic, 25 V.Wkg.
C28	2,000μF electrolytic, 25 V.Wkg.
C29	100μF electrolytic, 25 V.Wkg.

Inductors

T1	Speaker matching transformer, 8Ω and 16Ω or 8Ω and 15Ω, minimum rating 10 watts
T2	Mains transformer, secondary 0–12–15–20–24–30 volts at 2 amps, Douglas type MT3AT
L4	P.A. output coil, wound on ferrite rod 6ins. by ½in. diameter

Semiconductors

TR7	BD123
TR8	BFY50/2N3053
TR9	2N3053
TR10	2N3250/2N3905/2N3702
TR11	2N3055
D1–D4	Silicon rectifiers, 2A 100 P.I.V.
ZD2, 3	6.8V 200mW zener diodes

Switches

S1	5-pole 3-way, wafer
S2	s.p.s.t. toggle

Meter

M1	0–2A meter

Neon

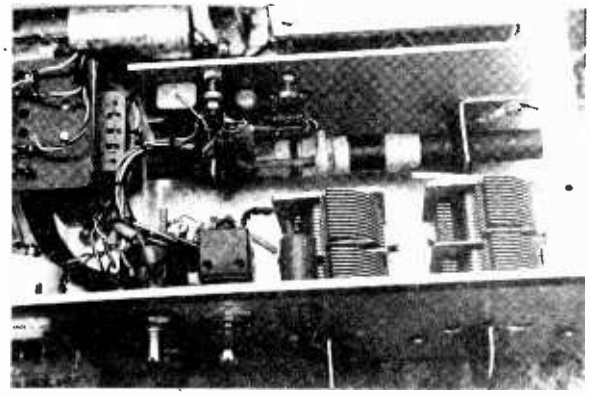
NE1	Panel-mounting neon assembly with integral series resistor

Fuses

F1–3	2 amp anti-surge, with holders

Miscellaneous
Ferrite lead
2 coaxial sockets
4-way tagstrip
3 pointer knobs
Printed circuit board
16 s.w.g. aluminium
Coaxial cable

The ferrite rod, on which is wound the output coil, is clearly visible here. The component to the left of the rod is the modulation transformer



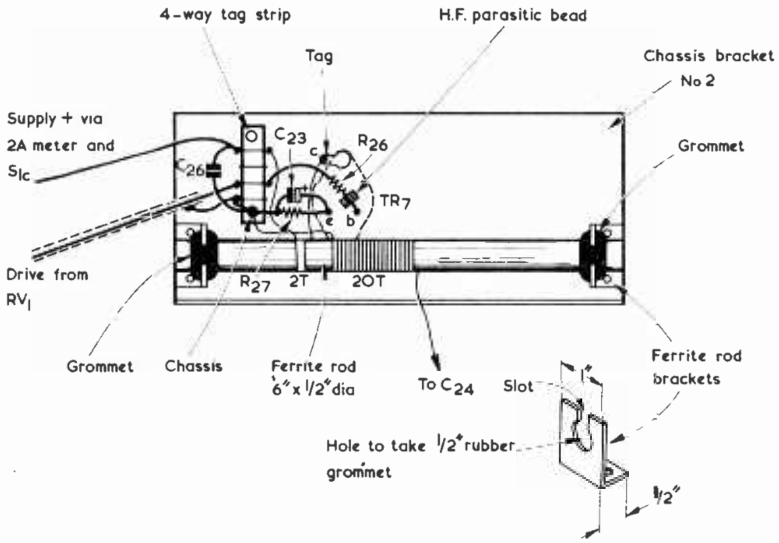


Fig. 12. Physical layout of the p.a. stage. The parts are mounted on Chassis Bracket No 2

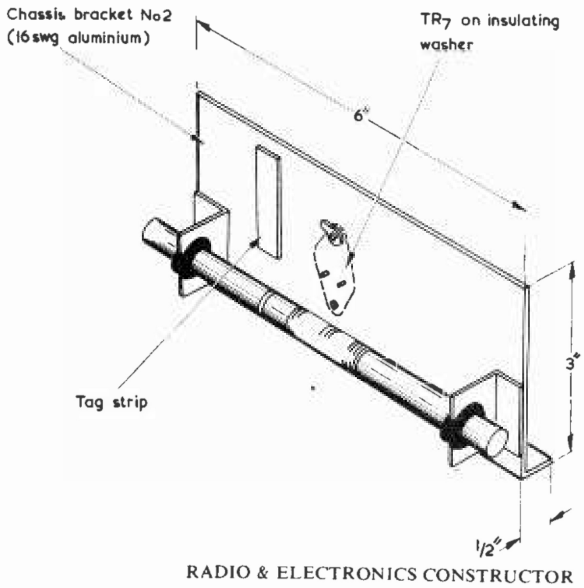


Fig. 13. Details of the Chassis Bracket No 2

Do not attempt to increase the p.a. efficiency (which is about 60%) by increasing the number of turns on the collector winding of L4, as this will cause 'jump tuning' and poor output waveform, resulting in TVI.

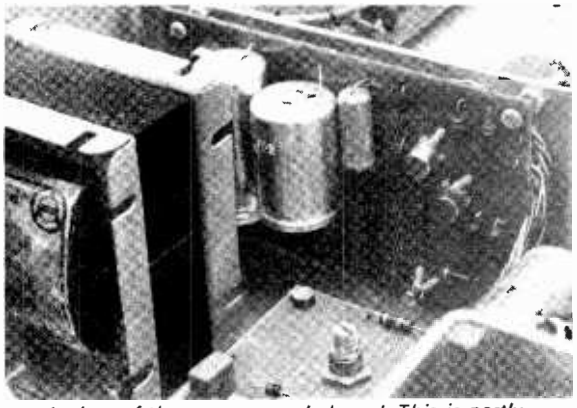
Also, do not use a smaller ferrite rod for L4 or saturation of the ferrite may result, destroying the transformer action. If desired, use a larger ferrite rod but *do* ensure that it is suitable for operation at 2MHz, as many ferrite grades are not. The rod used by the author is 6ins. long by ½in. diameter, and was obtained from G. W. Smith & Co. (Radio) Ltd., 3 Lisle St., London, W.C.2.

The construction of the p.a. stage is shown in Fig. 12. The output transistor is fitted to Chassis Bracket No. 2, the dimensions of which are given in Fig. 13. The transistor is insulated from the bracket by means of the usual mica washer and insulated mounting bushes, and its body is on the opposite side of the bracket to the ferrite rod. The latter is secured by two brackets with slots in the holes through which the rod passes. The slots prevent shorted-turn action. The earthy end of the 20 turn winding is that which is closer to the collector winding. A 4-way tagstrip is also mounted on the bracket.

Fig. 11 also shows the switching carried out by S1(a) to (e). This is quite simple and straightforward and the circuits controlled at each switch position can be readily traced through. The modulation transformer T1 is a speaker matching transformer having taps at 8Ω and 16Ω. A transformer having taps at 8Ω and 15Ω could alternatively be employed if this should prove easier to obtain. Whatever transformer is employed *must* have a power capability of at least 10 watts audio handling.

As will be illustrated in greater detail in next month's article, in which the general assembly will be dealt with, switch S1, driver potentiometer RV1 and meter M1 are all mounted on the front panel of the transmitter. So also are C24 and C25, the 'Tune' and 'Load' capacitors. The frame of the 'Tune' capacitor is insulated from the chassis by mounting it on a sheet of Paxolin. The frame of the 'Load' capacitor is bolted direct to the panel. In practice both capacitors consist of 2-gang 500 + 500 pF components with the two sections in parallel.

The modulation transformer, T1, is positioned between the v.f.o. box and Chassis Bracket No. 2.



A view of the power supply board. This is partly obscured by the mains transformer

POWER SUPPLY

The circuit diagram of the power supply is shown in Fig. 14. The design incorporates the simplest form of regulation for the 12 volt supply, using zener diodes

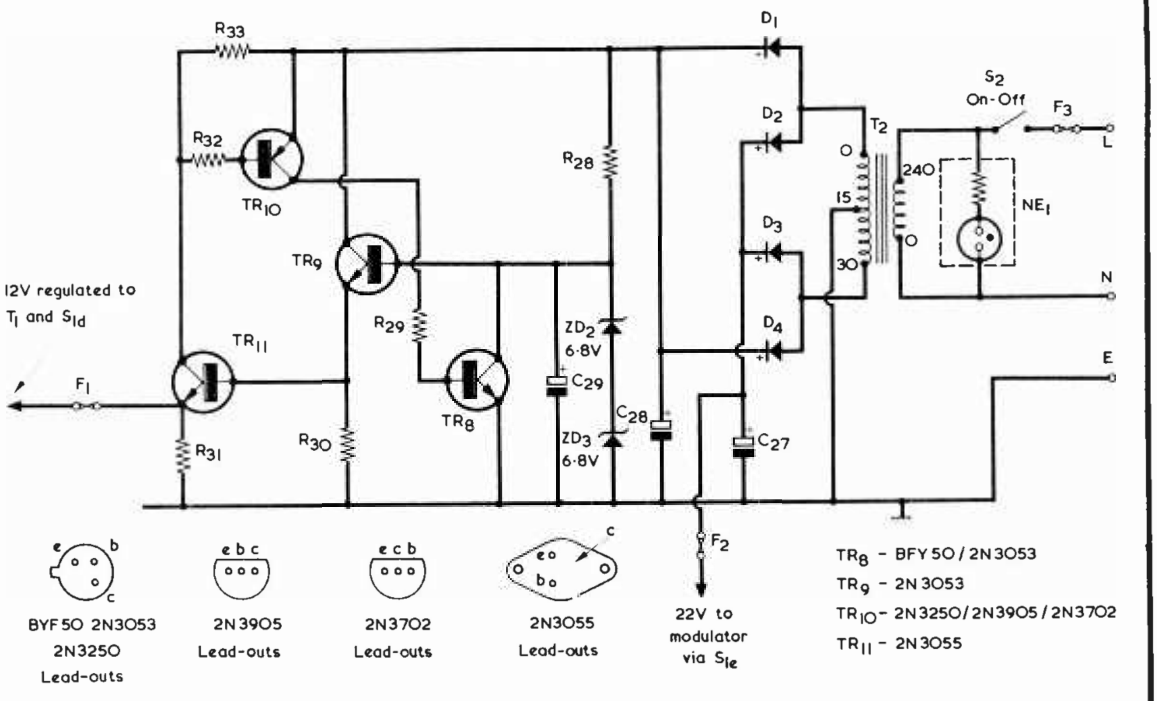


Fig. 14. The circuit of the power supply. This offers both regulated and unregulated outputs

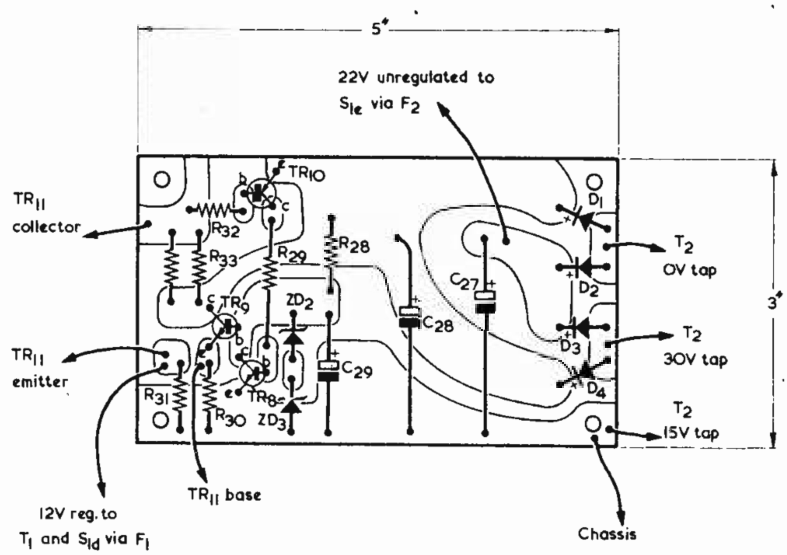


Fig. 15. The power supply printed circuit board, as seen from the component side.

ZD2 and ZD3 and the emitter followers TR9 and TR11. Overload protection is given by TR10 and TR8. If the current drawn through R33 causes a voltage to appear across it which is sufficiently high to allow base current to flow in TR10, this transistor becomes conductive. Its collector current flows in the base circuit of TR8, whereupon TR8 causes a reduction in the voltage across ZD2 and ZD3 and, in consequence, in the regulated output. The current limit is 2.5 amps.

A 22 volt unregulated supply is also provided for the Class B modulator.

The mains tranformer, T2, has a number of secondary tappings, of which only the 0, 15 and 30 volt tappings are employed here. The 15 volt tapping becomes the earthed centre-tap in this arrangement.

The use of fuses in the mains input and regulated and unregulated output circuits is recommended, and they can be located in any available space in the transmitter. A neon mains indicator lamp with integral series resistor may be fitted, if desired.

The printed circuit board for the power supply is reproduced, full size, in Fig. 15. The view is from the component side of the board. In the prototype R33 is made up of two ½ watt 0.5Ω resistors in parallel and two resistors are shown, in Fig. 15, in the R33 position. The board is mounted, with spacing stand-off washers to Chassis Bracket No. 3, which is illustrated in Fig. 16. The bracket also acts as a heat sink for TR11, the body of which is on the opposite side of the bracket to the board. TR11 is insulated from the bracket by a mica washer and insulated mounting bushes.

The whole power supply (both 12 and 22 volt outputs) may be replaced by a car battery or other 12 volt accumulator (but *not* by dry batteries, which cannot supply the current required). The author's transmitter incorporates additional sockets and switching to achieve this. It should be pointed out, however, that when running from a 12 volt supply the modulator will not supply the output required for 100% modulation. Incidentally, the 22 volt output from the mains power supply will, of course, drop in voltage under load but this is not detrimental to the modulation quality unless excessive bass frequencies are present.

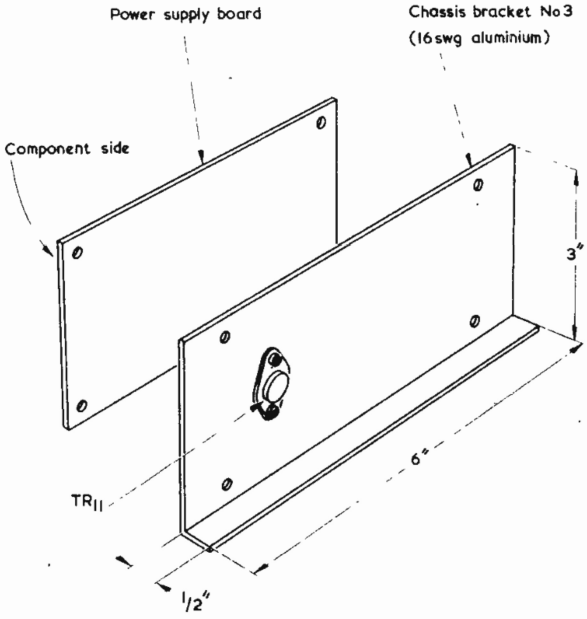


Fig. 16. Fitting the power supply board to Chassis Bracket No 3

(To be concluded)